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# PERFORMANCE OF VIGILANCE AND MONITORING TASKS AS A FUNCTION OF WORKLOAD

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## FOREWORD

This study was initiated by the Training Research Division of the Behavioral Sciences Laboratory, Aerospace Medical Research Laboratories, Aerospace Medical Division, Wright-Patterson Air Force Base, Ohio.

The research was conducted by T. J. Hall; G. E. Passey, PhD; and T. W. Meighan of the Lockheed-Georgia Company, under Contract No. AF 33(657)-10506, Task No. 171002, "Combined Effects of Sleep Loss and Demanding Work Rest Schedules on Crew Performance." The research reported herein is part of a program begun in December of 1962 and completed in April 1964. Dr. G. E. Passey served as Project Director. W. Dean Chiles, PhD, Assistant Chief, Training Research Division, served as Task Scientist and Consultant.

This technical report has been reviewed and is approved.

WALTER F. GRETHER, PhD
Technical Director
Behavioral Sciences Laboratory

## ABSTRACT

This study was conducted to obtain control data on the performance of three passive tasks—auditory vigilance, warning lights monitoring, and probability monitoring—performed previously in conjunction with three active tasks. Subjects were tested for 4 hours on each of 6 successive days. A task schedule requiring performance of all six tasks was employed on 2 hours of each daily session, while performance on the passive tasks alone was carried out during the remaining 2 hours. Performance on auditory vigilance, green warning lights, and probability monitoring was found to be superior when these passive tasks were performed alone. No difference in performance was found for red warning lights.

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# SECTION I

# INTRODUCTION

In previous studies from this laboratory, subjects have been required to perform on a battery of six tasks presented on a basic 2-hour schedule. A detailed description of the tasks and apparatus employed is contained in a previous report.[1] Performance periods in which the subjects performed only monitoring and vigilance tasks were provided during the beginning and terminal 15 minutes of the basic 2-hour program. Because of the requirements of these previous experiments, subjects were allowed to leave their stations during these end periods for purposes of attending to toilet needs or to obtain food and drink, and it was during this time that watches were relieved. In addition, meals were eaten during these periods with a general effect of degrading performance on the assigned monitoring tasks. Because of these disruptions in performance, the data acquired during the terminal periods were typically not analyzed; hence, the performance on only the monitoring tasks as compared to full battery task performance has not been examined. The present study was undertaken to provide data which would allow comparison of performance on the vigilance and monitoring tasks alone with performance of these tasks under the varying load conditions imposed by the basic 2-hour program.

The additional perceptual-psychomotor requirements of the full battery task program might be expected to act in any of several ways on monitoring performance; eg, the additional tasks may act either as distractors, or as activators, or may require time-sharing performance by the operator.

Reaction to distraction is a very complicated affair, but it is dependent largely upon such subject variables as expectation and motivation. A distractor, to be classified as such, must not interfere directly with the ongoing performance. If the task calls for the monitoring of an auditory signal, extraneous sounds would be more than distractors since they would mask the signal. Visual distractors would be used in such a case. When the task demands use of the eyes, auditory distractors are usually employed. With young adults, properly motivated, the result of such an experiment is usually that the distractor does not distract, except perhaps for a short time while the subjects are becoming adjusted to the situation.

It can be deduced from arousal theory that novel task-irrelevant information would increase the total variability of the stimulus situation; this would raise the level of cortical arousal, and detection efficiency would be improved. In the study presented here, however, the additional stimuli present in the full battery task presentation cannot be considered as irrelevant or extraneous to the subject's total performance and, hence, cannot be regarded merely as activators of monitoring performance.

A more appropriate prediction in this case would be that the subjects are required to time-share their activities during the full battery task presentation, resulting in a loss of efficiency in monitoring performance. In studies on division of attention, the usual conclusion is that simultaneous performances of attentive acts of cognition do not often, if ever, occur without decrements. Usually one or both of two simultaneous performances will show some impairment. The specific question to be answered in the present study was whether or not performance on the monitoring tasks was affected when accomplished under conditions of additional task loading.

[1] Alluisi, E. A., Chiles, W. D., and Hall, T. J., Combined Effects of Sleep Loss and Demanding Work-Rest Schedules on Crew Performance, AMRL TDR-64-63, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, June 1964.

# SECTION II

# METHOD

In the present study, two groups of 5 subjects each were given instruction on the task battery over a period of 4 successive days, covering Wednesday through Saturday of one week, and then required to perform for two 2-hour test periods each day for 6 successive days beginning on the Monday following training.

## SUBJECTS

The subjects were all male college students who were paid for their services. The average age of subjects was 20.3 years for the first experimental group and 20.0 years for the second experimental group.

## ORIENTATION AND TRAINING

Most of the first day of training was devoted to orientation, general briefings concerning the purpose of the research, and descriptions of the test plans. The second, third, and fourth days were spent in training on the task program. Emphasis was placed on the role of the crew commander with respect to his responsibilities, the importance of individual effort on the monitoring tasks, and the need for crew coordination in performing the group tasks.

Each crew spent approximately twelve hours learning to perform on various combinations of the 6 tasks used. These training periods utilized task combinations conforming to appropriate portions of the basic 2-hour testing program.

Physical conditions in the laboratory were arranged so that the subjects could interact only with the project leader and designated assistants during the orientation phase. While training in the test facility, the subjects could interact only with the experimenter who served as the shift leader, and then only over an intercom system. In other words, a cordial but semiformal and business-like relation was established and maintained between the crew members and the experimenters at all times. During the training period, questions and comments regarding the nature of the tests were encouraged. Rapport between the experimenters and subjects was excellent, both during training and throughout the experiment.

## TESTING

The testing was carried out between the hours of 1630 and 2130 daily. Table I shows the task performance schedule for days 1, 3 and 5. On days 2, 4 and 6, an inversion of this schedule was utilized; ie, monitoring and vigilance tasks alone were presented in the second 120-minute period.

An alerting buzzer was sounded 2 minutes prior to the start of each period, and a countdown was utilized during the final minute before the start of the period. The 10-minute break was spent in the leisure area of the facility, and the subjects were given soft drinks.

Communication was limited to the intercom system. The subjects were instructed to keep intercom conversation to a minimum, and the only calls permitted between the subjects and the experimenters were "business" calls such as those required to report an apparent malfunction of equipment.

TABLE I

PERFORMANCE SCHEDULE
FOR DAYS 1, 3, AND 5*

| TASK | 00–15 | 15–30 | 30–45 | 45–60 | 60–75 | 75–90 | 90–105 | 105–120 | 120–130 | 130–145 | 145–160 | 160–175 | 175–190 | 190–205 | 205–220 | 220–235 | 235–250 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auditory | xxx | xxx | xxx | xxx | xxx | xxx | xxx | xxx | B | xxx | xxx | xxx | xxx | xxx | xxx | xxx | xxx |
| W-Lights | xxx | xxx | xxx | xxx | xxx | xxx | xxx | xxx | R | xxx | xxx | xxx | xxx | xxx | xxx | xxx | xxx |
| Probability | xxx | xxx | xxx | xxx | xxx | xxx | xxx | xxx | E | xxx | xxx | xxx | xxx | xxx | xxx | xxx | xxx |
| Arithmetic | | | | | | | | | A | | xxx | xxx | | | | | |
| Code-Lock | | | | | | | | | K | | | xxx | xxx | xxx | xxx | | |
| Target-I.D. | | | | | | | | | | | | | | | xxx | xxx | |

* x represents 5-minute interval

Prior to test sessions of day 4, the subjects were reminded that communication concerning tasks should be limited to those in which communications were called for. Previous experience suggested that some cooperative behavior on individual tasks might be expected at about this time in the experiment.

## SECTION III

## RESULTS AND DISCUSSION

Four of the 6 tasks used in the test battery were individual-performance tasks in the sense that one individual's performance need not affect (nor be affected by) any other individual's performance, and also in the sense that where a subject was provided knowledge of results it was solely with regard to his own performance. (In the auditory vigilance task, no knowledge of results was provided any subject.) The pertinent results obtained with these individual tasks are summarized below, with particular emphasis on differences in performance on the three monitoring tasks (auditory vigilance, warning lights monitoring, and probability monitoring) under the two conditions of task presentation, ie, monitoring tasks only as opposed to the full task battery. The figures and analyses presented here represent the data of four subjects in each group who completed all 6 days of testing. One subject in each group failed to report for test on day 4. As shown in Table I, only monitoring tasks were presented during the beginning and terminal 15 minutes of each 2-hour testing period; therefore, data analysis was restricted to the middle 90 minutes of each 2-hour period.

### INDIVIDUAL PERFORMANCE MEASURES

Auditory Vigilance.--Figure 1 shows the mean percentage of auditory vigilance signals correctly detected during each day of testing. Table II summarizes an analysis of variance of these data. Examination of the table will reveal a significant between-groups effect for auditory vigilance and for probability monitoring detection time.

A review of the data did not reveal a constant group difference from one task to another, nor was there a significant response-group interaction for any measure except probability monitoring detection time. The effect of primary concern in this study was that of the two response conditions -- monitoring only, and monitoring with the full task battery. Therefore, it was felt that no purpose would be served by plotting the data for each group separately. Figure 1 graphically displays the effect of the 2 response conditions on auditory-vigilance performance. The 2 performance curves appear to diverge, with auditory-vigilance performance, while monitoring only, showing some slight improvement over the 6 days of testing. Auditory-vigilance during presentation of the full task battery exhibited a slight decrement over days, such as has been previously observed in studies of this type. This decrement may be due to the additional workload imposed on the remaining crewmembers in the group-tasks by the loss of a subject at the end of day 3; but from the data available, it more likely represents a shift in interest to the more active tasks, ie, arithmetic computations, target identification, and code-lock solving.

Figure 2 contains a plot of the mean number of auditory-vigilance signals correctly detected during each 15-minute segment of the basic 2-hour task program under the 2 conditions of task presentation. During full battery performance, the 8 points of the curve represent the following operator loadings: (1) monitoring tasks only; (2) monitoring tasks and arithmetic computations; (3) monitoring tasks, arithmetic computations, and code-lock solving; (4) and (5) monitoring tasks and code-lock solving; (6) monitoring tasks, code-lock solving, and target identifications; (7) monitoring tasks and target identifications; and (8) monitoring tasks. It is interesting to note that during the 15-minute end period of the full battery program (when the subjects are again performing only monitoring tasks), performance on the three monitoring tasks returns to a level not

Figure 1 - Mean Percentage of Auditory-Vigilance Signals Correctly Detected During Each Day of Testing.

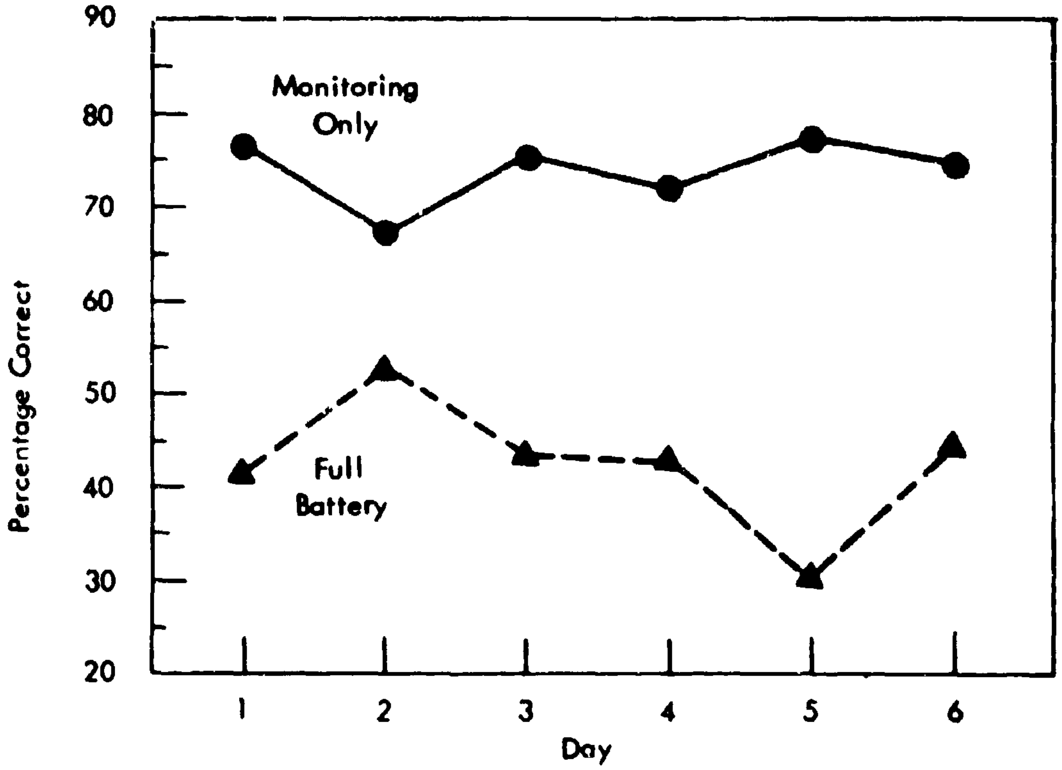



Figure 2 - Mean Percentage of Auditory-Vigilance Signals Correctly Detected During Each 15-Minute Period of the Basic 2-Hour Task Program.

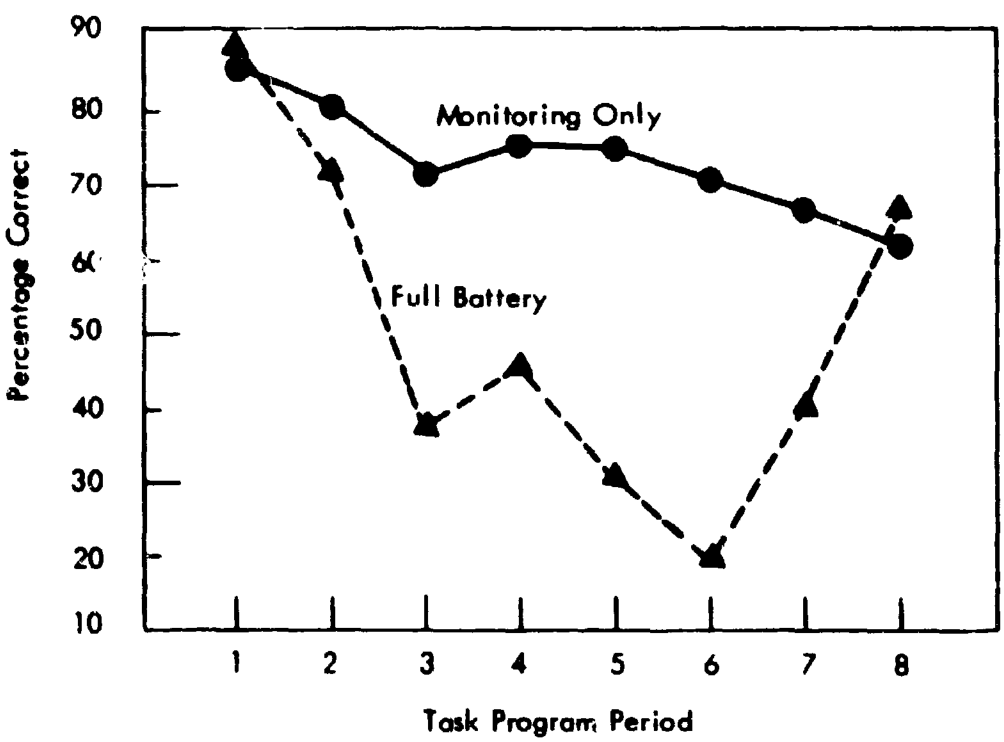


TABLE II

SUMMARIES OF ANALYSES OF VARIANCE FOR THREE MONITORING TASKS

| | | Auditory Vigil. % Correct | | Red Warn. Lgts. Resp. Latency | | Green Warn. Lgts. Resp. Latency | | Probability Detect. Time | | Probability % Correct | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Source of Variation | d.f. | Mean Square | F | Mean Square | F | Mean Square | F | Mean Square | F | Mean Square | F |
| Days | 5 | 75.2 | -- | 1.548 | 1.78 | 4.930 | 3.77** | 267.3 | 1.28 | 4.8 | -- |
| Response Condition | 1 | 22350.4 | 67.24** | 8.992 | 2.43 | 86.526 | 24.26** | 9538.1 | 27.22** | 6.1 | -- |
| DR | 5 | 458.8 | 4.08** | 2.912 | 2.26 | 2.591 | 1.85 | 463.7 | 2.74* | 8.0 | 1.46 |
| Groups | 1 | 8618.5 | 7.96** | 49.192 | 1.63 | 60.167 | 2.47 | 8149.4 | 7.23* | 1.5 | -- |
| DG | 5 | 532.5 | 4.89** | 1.538 | 1.77 | 3.608 | 2.76* | 648.2 | 3.83** | 4.2 | -- |
| RG | 1 | 266.0 | --- | 4.109 | 1.11 | 3.360 | -- | 2649.1 | 7.56* | 7.8 | -- |
| DRG | 5 | 276.8 | 2.46 | 1.143 | -- | 2.727 | 1.95 | 547.1 | 3.23* | 8.8 | 1.62 |
| Subjects (G) | 6 | 1082.7 | | 30.235 | | 24.314 | | 1127.3 | | 8.7 | |
| DS (G) | 30 | 109.0 | | 0.870 | | 1.306 | | 208.9 | | 6.5 | |
| RS (G) | 6 | 332.4 | | 3.703 | | 3.567 | | 350.4 | | 15.3 | |
| DRS (G) | 30 | 112.3 | | 1.290 | | 1.398 | | 169.4 | | 5.4 | |
| TOTAL | 95 | | | | | | | | | | |

* $\underline{P}$ less than .05

** $\underline{P}$ less than .01

substantially different from that attained during the 2-hour period in which only monitoring tasks are presented. This would seem to indicate a lack of any long-term decrement or carry-over effect from the additional loadings. Table III shows a summary of analyses of variance between these 15-minute segments for the middle 90 minutes of each 2-hour performance period. The point of interest in this table is that, while auditory vigilance shows no significant deviations during the monitoring-only periods, there is a highly significant difference between 15-minute segments of the full battery presentation. This appears to indicate a differential operator loading for the various task combinations, with the monitoring-code lock-target ID combination detracting most from auditory-vigilance performance.

Warning-Lights Monitoring.--The mean response latency (normalized scale) in detecting warning light signals during each day of testing is presented in Figure 3 for red lights and Figure 5 for green lights. Although performance was generally better while performing only monitoring duties, no significant differences were found with respect to red warning lights. Apparently the occurrence of a red light coming on provided sufficient stimulation under both response conditions to elicit a rapid response from the subjects. Such was not the case with green warning lights. A clearly significant difference exists between the two conditions of operator loading as evidended both in Figure 5 and in Table II, with more rapid detection of green warning light signals occurring while performing only monitoring tasks. The lack of parallelism on days 1 and 4 is probably attributable to excessive concentration on the group tasks during these 2 days due to the novelty of the group-task situation on day 1 and to the additional workload imposed on the remaining crewmembers on day 4.

In Figure 4 and Table III, the effect of variation in task load on response latency to red warning lights is shown for the 15-minute segments of the 2-hour task program. As was the case with the between-day analysis for this task, no clear distinction can be made regarding the effects of task-program content. Again this is considered to be a product of the high stimulus value of a red warning light signal within the field of view of the operator.

Figure 6 shows response latency to green warning light signals as a function of task program period and task load. Similar to the between-day analysis for this task, a clearly defined difference was obtained for the 2 types of task loadings (ie, full battery and monitoring only). As was the case with auditory vigilance, the 15-minute end period of the full battery program (during which only monitoring tasks were presented) elicited performances essentially the same as those attained with a full 2 hours of monitoring alone. Again, this is taken as an indication of a lack of residual decrement induced by the high task loadings during the full battery program. Table III shows a highly significant variation in performance on green warning lights between 15-minute segments of the full battery task presentation. As was the case with auditory vigilance, this is taken to indicate a differential operator loading for the various task combinations with the most highly loaded periods (task program periods 3 and 6) detracting most from green warning light detections.

Probability Monitoring.--Two measures of probability-monitoring performance were taken, ie, mean detection time and percentage of signals correctly detected. Percent correct detections consistently averaged better than 97.0 percent, and no significant differences were evidenced in the analysis of variance as indicated in Tables II and III. In the case of mean detection time, however, a highly significant difference was found between the two response conditions. In Figure 7, the two performance curves for mean detection time appear to be converging though it is doubtful that, even in a longer study, detection time during full battery presentation would reach the low values achieved with only the monitoring tasks.

Figure 3 - Mean Response Latency in Detecting Red Warning-Light Signals During Each Day of Testing.

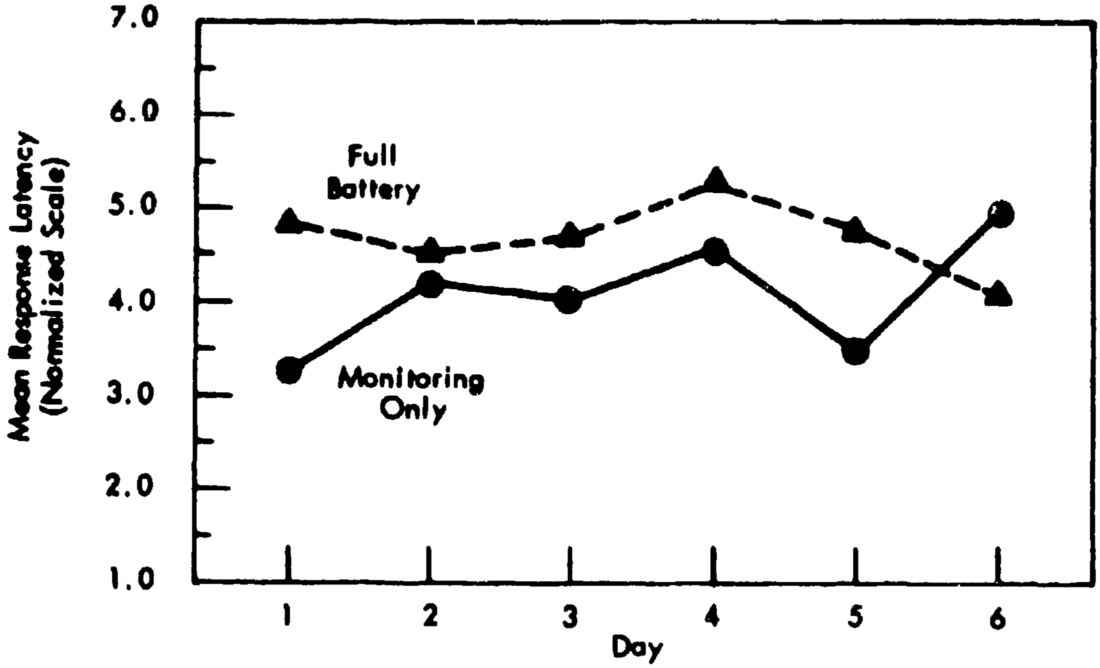



Figure 4 - Mean Response Latency in Detecting Red Warning-Light Signals During Each 15-Minute Period of the Basic 2-Hour Task Program

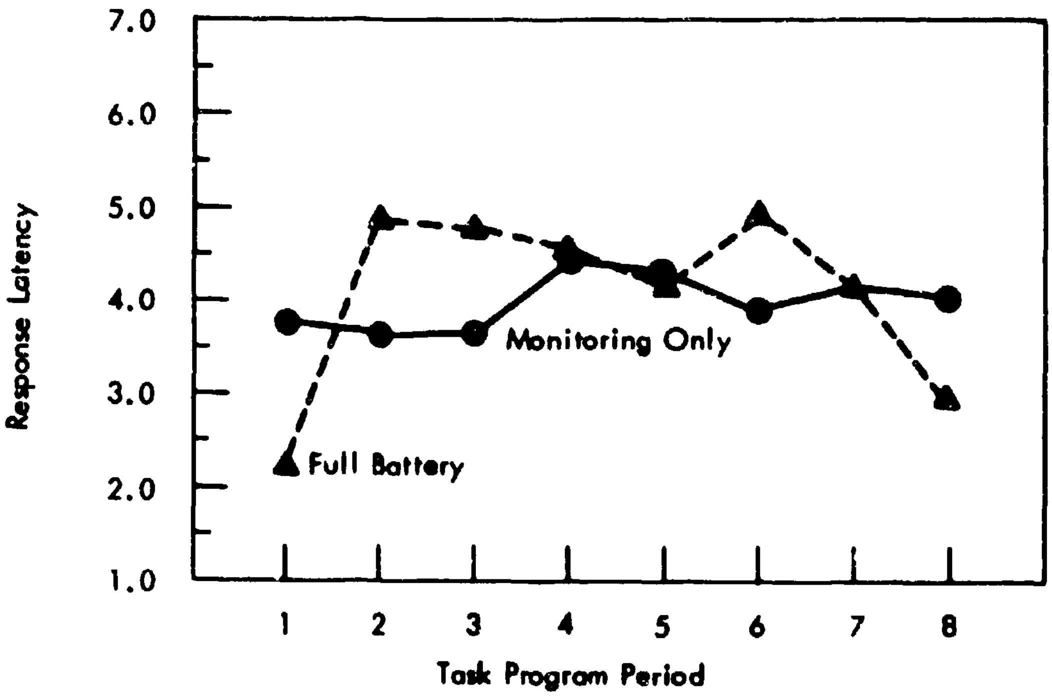


Figure 5 - Mean Response Latency in Detecting Green Warning-Light Signals During Each Day of Testing

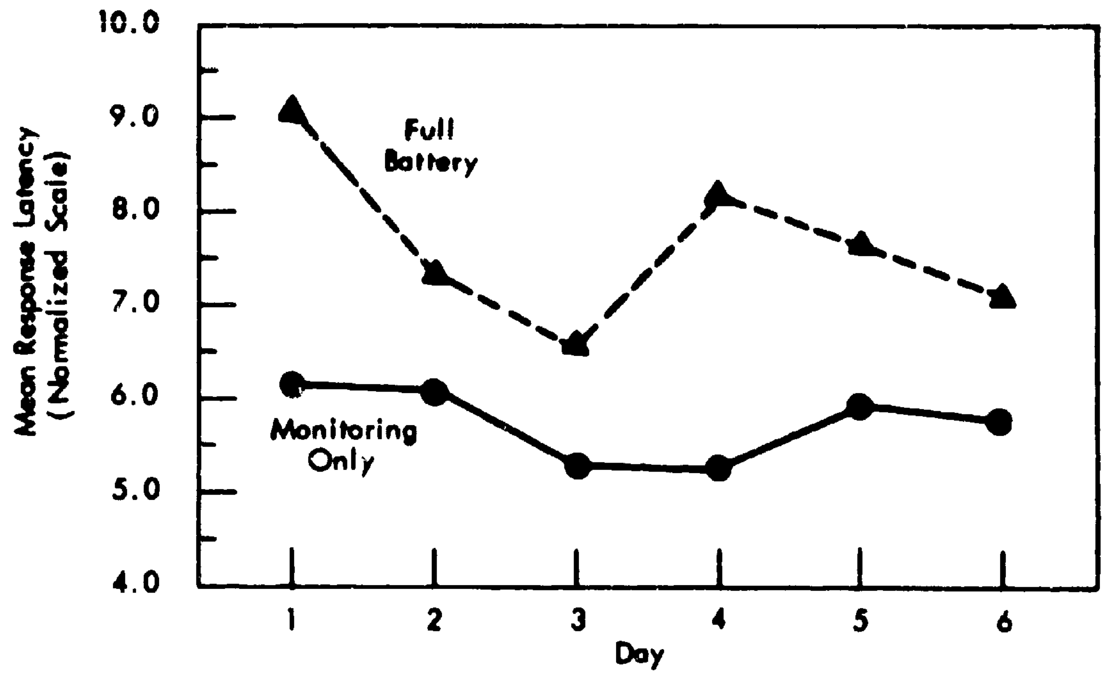



Figure 6 - Mean Response Latency in Detecting Green Warning-Light Signals During Each 15-Minute Period of the Basic 2-Hour Task Program

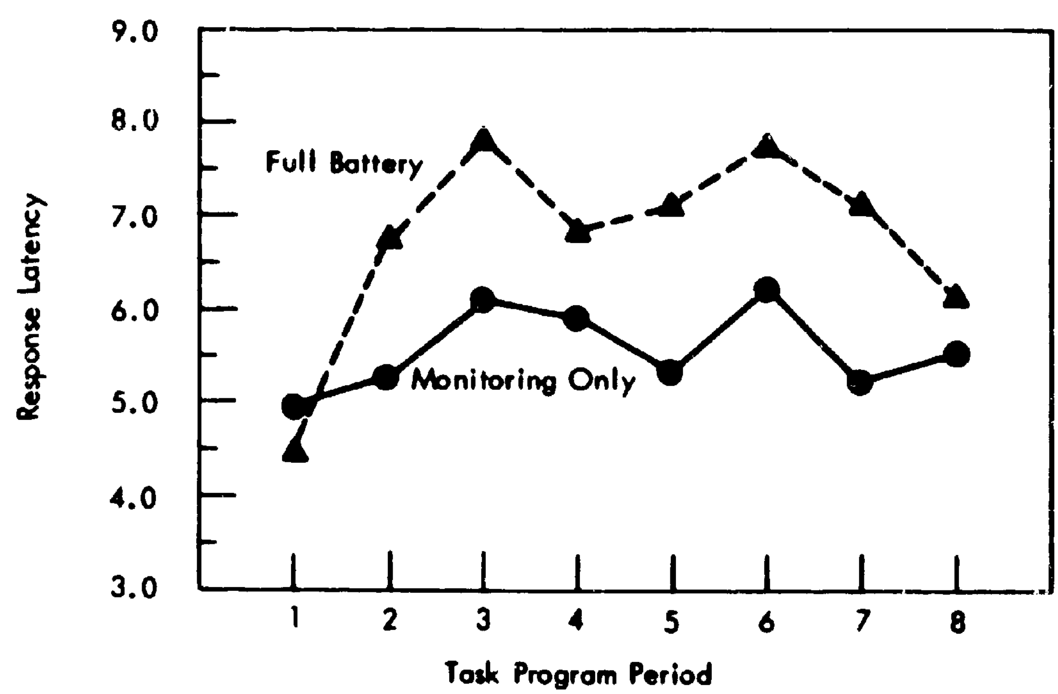


TABLE III

SUMMARY OF ANALYSES OF VARIANCE*
BY RANKS OF WITHIN-DAY LEVELS
OF MONITORING TASK PERFORMANCE

| | Full Battery | | Monitoring Task Only | |
|---|---|---|---|---|
| Monitoring Task | Chi-Square | p-level | Chi-Square | p-level |
| Auditory Vigilance % Correct | 27.66 | .001 | 10.63 | n.s. |
| Red Warning Lights Response Latency | 8.43 | n.s. | 4.34 | n.s. |
| Green Warning Lights Response Latency | 13.66 | .02 | 2.86 | n.s. |
| Probability Monitoring Detection Time | 17.07 | .01 | 0.57 | n.s. |
| Probability Monitoring % Correct Detections | 2.21 | n.s. | 0.43 | n.s. |

* Friedman's analysis of variance

n.s. -- not significant

Figure 8 and Table IV portray the effect of full battery loading on mean detection time during each of the 15-minute periods of the basic 2-hour task program. The effect of the additional task load closely parallels the results obtained with auditory-vigilance monitoring (shown in Figure 2). Note that monitoring performance during the 15-minute end period of the full battery program does not differ substantially from the level of performance attained during the full 2 hours of monitoring only. Also, as was the case with auditory vigilance and green warning lights, there is a highly significant variation in detection time between task program periods during full battery presentation with the longest detection times occurring during the most highly loaded periods.

Arithmetic Computations.--Figure 9 shows the mean percentages of arithmetic problems correctly computed during each day of testing.

Figure 7 - Mean Detection Time for Correct Detections of Probability-Monitoring Signals During Each Day of Testing

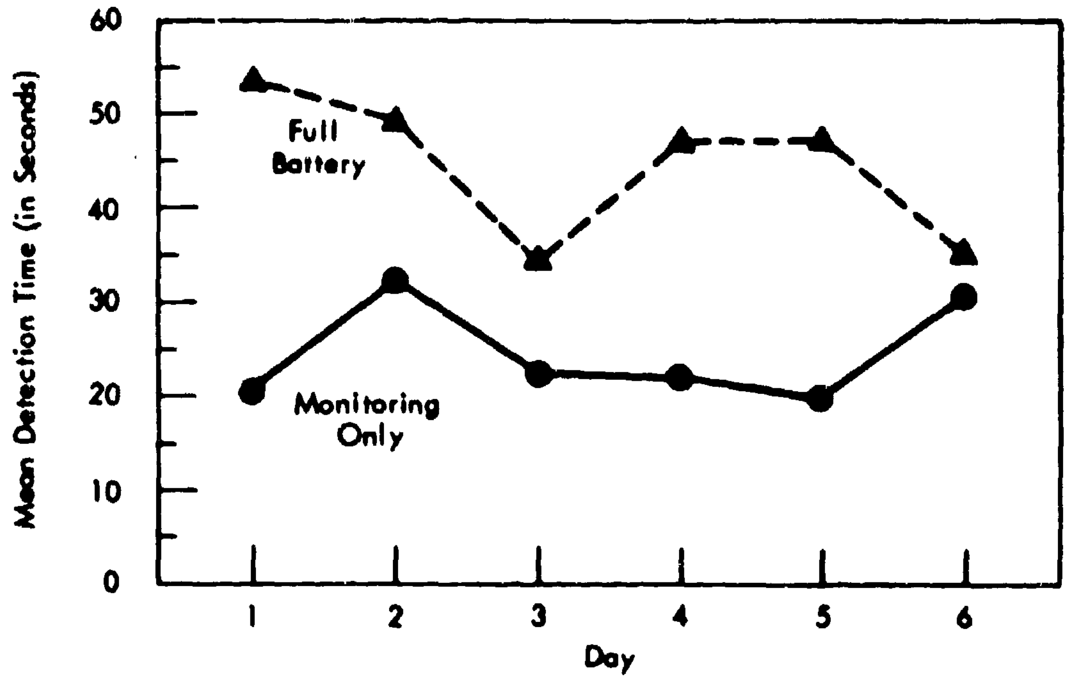
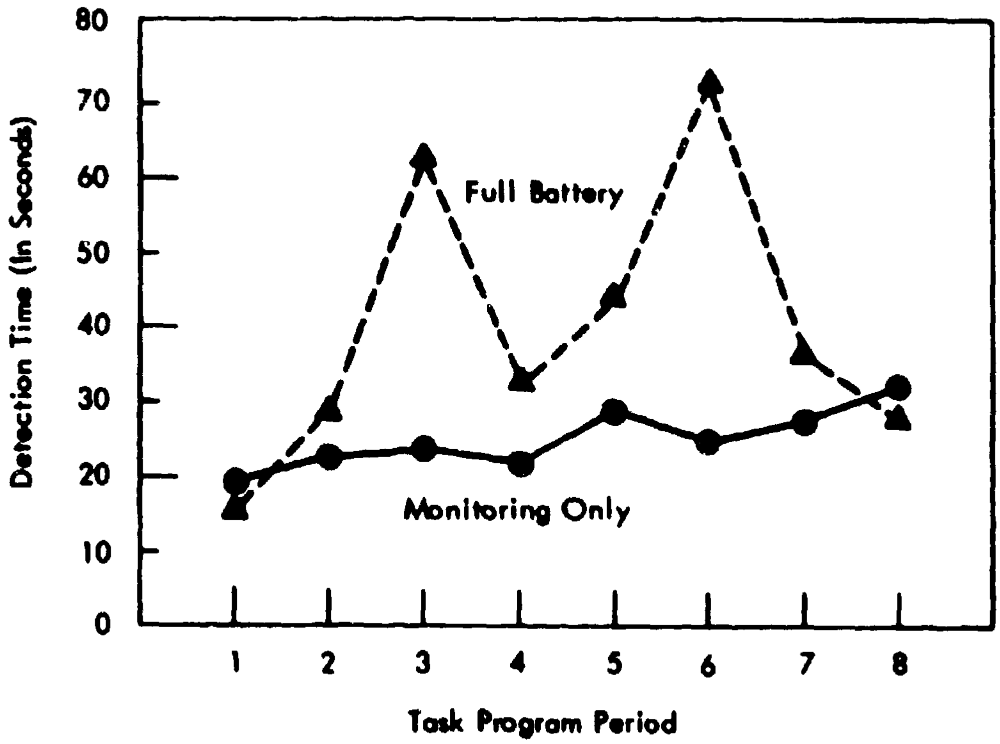



Figure 8 - Mean Detection Time for Correct Detections of Probability-Monitoring Signals During Each 15-Minute Period of the Basic 2-Hour Task Program



They are plotted separately for each of the 2 different conditions under which arithmetic computations were made, ie, for the solutions computed with and without simultaneous presentation of code-lock problems. Table IV summarizes an analysis of variance for these data.

Figure 9 reveals that the operator's ability to perform the mental computations necessary for solving the arithmetic problems was lowered by requiring him to attend concurrently to the code-lock task. This indicates that the code-lock task introduces a performance overload requiring the operator to rush his performance on the arithmetic task in order to attend to the code-lock problems. The rather severe drop in performance on day 4, "with code-lock," is due to the need to have one man work 2 stations to compensate for the missing crewmember in the code-lock task. These results parallel closely those obtained in previous studies and will not be elaborated further.

## GROUP PERFORMANCE MEASURES

While it was the primary concern of this study to investigate the effects of differences in operator-loading on performance at three monitoring tasks, the two groups tasks were analyzed and will be discussed here merely for the sake of completeness and for comparability with previous studies.

Target Identification.--In its present form this is a group-performance task highly dependent upon individual proficiency in pattern discrimination.

Each problem involves the participation of individual crew members in reaching an additional, joint, group-based identification. For simplicity, and in keeping with the purposes of the study, only the individual subject's data are presented here. As was the case with the arithmetic task, mean percentages of targets correctly identified during each day of testing are presented in Figure 10, separately for each of the 2 different conditions under which target identifications were made, ie, with and without concurrent presentations of code-lock problems. Table IV summarizes an analysis of variance of these data.

In agreement with previous experience, a significant difference was found between the 2 performance conditions under which targets were presented. These results rather closely parallel those found for the arithmetic task. Note that performance improved over the course of the study on both the arithmetic and target identification tasks, indicating a sustained level of motivation on the part of the subjects in spite of the loss of a crewmember from each group after the 3d day of testing.

Code-Lock Solving.--Three different criteria were used to evaluate the performance obtained in code-lock solving. Table V summarizes analyses of variance for these measures.

Figure 11 shows the mean number of code-lock sequences solved per minute on each day of testing. These results closely parallel previous experience with the code-lock task. Two distinctly different levels of performance were attained, and the average number of sequences completed per minute when solving code-lock problems "alone" (ie, with only the monitoring tasks) was greater than when solving these problems with either target identifications or arithmetic computations and the monitoring tasks. In each case, however; there was a significant improvement in

Figure 9 - Mean Percentage of Arithmetic Program Correctly Solved During Each Day of Testing

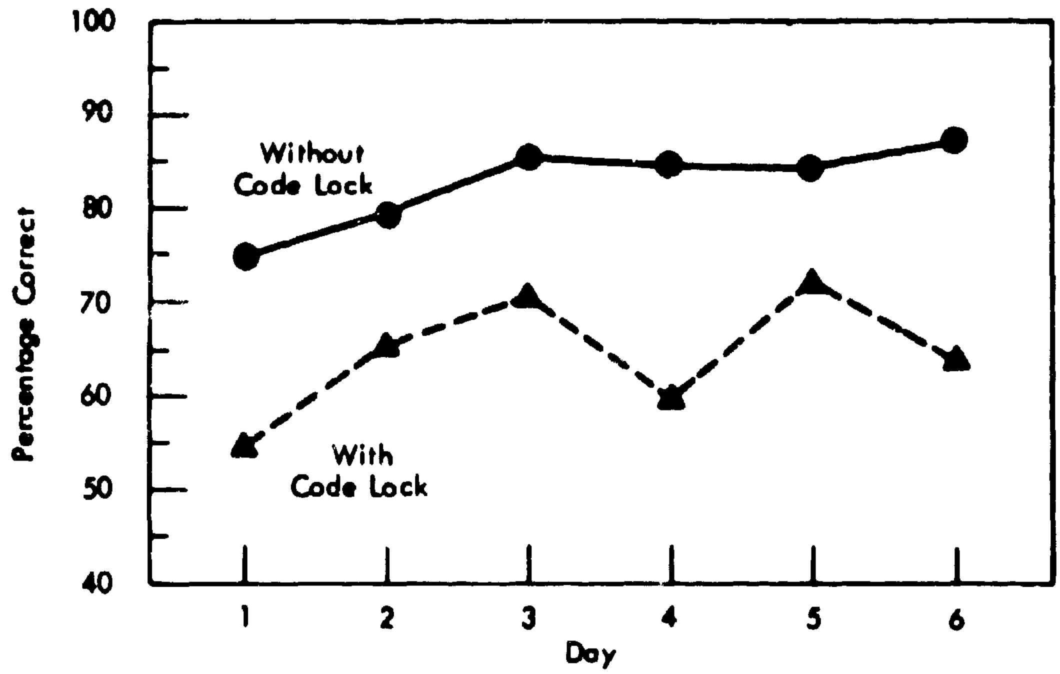



Figure 10 - Mean Percentage of Targets Correctly Identified By Individual Operators During Each Day of Testing

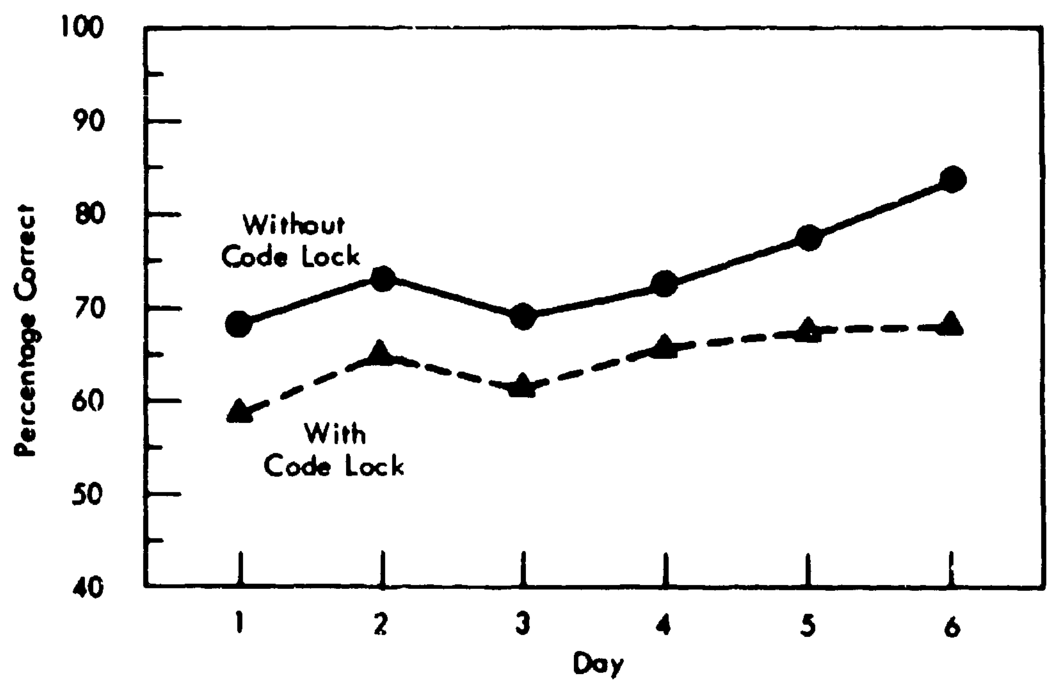


Figure 11. Mean Number of Code-Lock Sequences Solved Per Minute During Each Day of Testing.

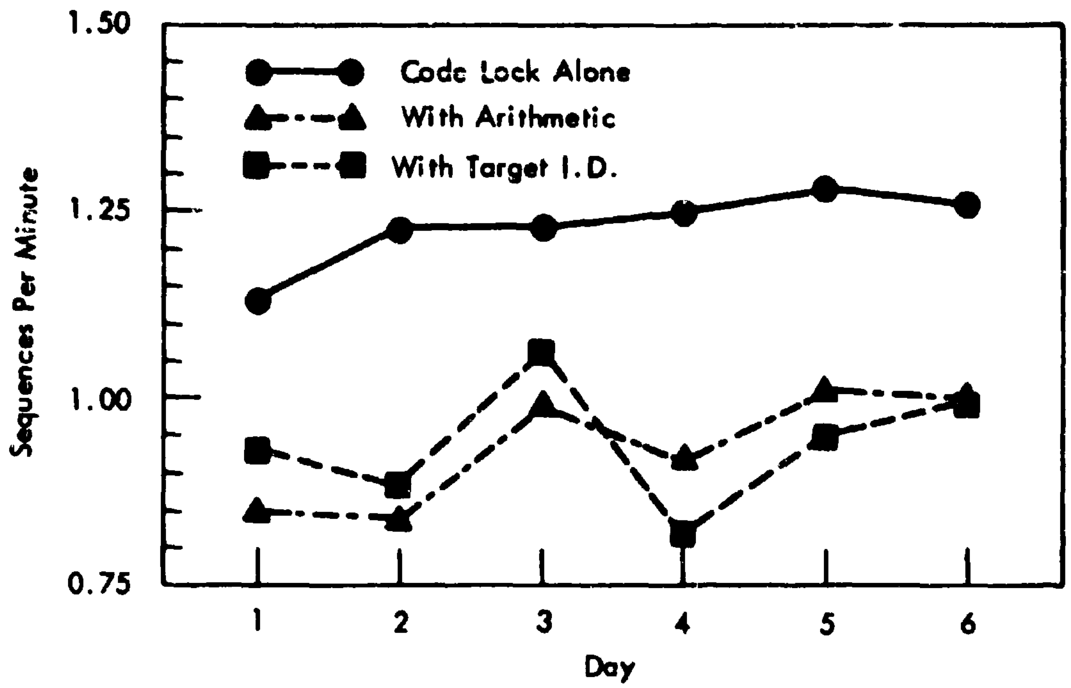
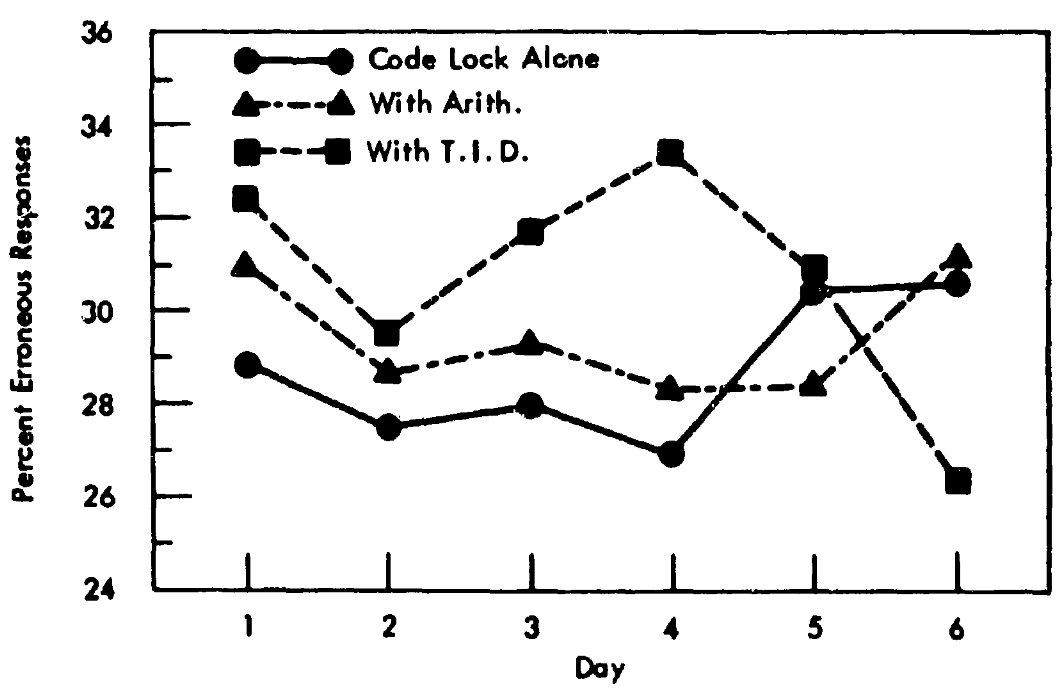



Figure 12 - Proportion of Erroneous Code-Lock Responses During Each Day of Testing



## TABLE IV

## SUMMARIES OF ANALYSES OF VARIANCE FOR MEAN PERCENTAGES OF CORRECT ARITHMETIC COMPUTATIONS AND CORRECT TARGET IDENTIFICATIONS

| | | Arithmetic % Correct | | Target I.D. % Correct | |
|---|---|---|---|---|---|
| Source of Variation | d.f. | Mean Square | F | Mean Square | F |
| Days | 5 | 392.7 | 4.63** | 320.4 | 2.74* |
| Response Conditions | 1 | 7979.0 | 30.70** | 2207.1 | 11.65* |
| DR | 5 | 108.1 | 1.90 | 44.1 | --- |
| Groups | 1 | 11432.0 | 2.43 | 5702.6 | 6.63* |
| DG | 5 | 127.8 | 1.51 | 96.2 | --- |
| RG | 1 | 496.8 | 1.91 | 0.2 | --- |
| DRG | 5 | 69.7 | 1.23 | 99.4 | 1.62 |
| Subjects (G) | 6 | 4699.6 | | 860.1 | |
| DS (G) | 30 | 84.9 | | 117.1 | |
| RS (G) | 6 | 259.9 | | 189.4 | |
| DRS (G) | 30 | 56.8 | | 61.5 | |
| TOTAL | 95 | | | | |

* P less than .05

** P less than .01

performance over the course of the study. The rather erratic performance on day 4 is presumably due to the additional workload thrown on the crew commander by the loss of a crewmember at the end of day 3.

Percent erroneous responses and time per individual response are shown in Figures 12 and 13, respectively. In general, these measures reflect the comments regarding mean sequences per minute, although the differences in performance levels are not so marked as the case of mean suquences per minute. Again, the erratic performance on days 4, 5, and 6 is probably attributable to the extra workload placed on the crew commander.

Figure 13 - Mean Time per Response on Code-Lock Problems During Each Day of Testing

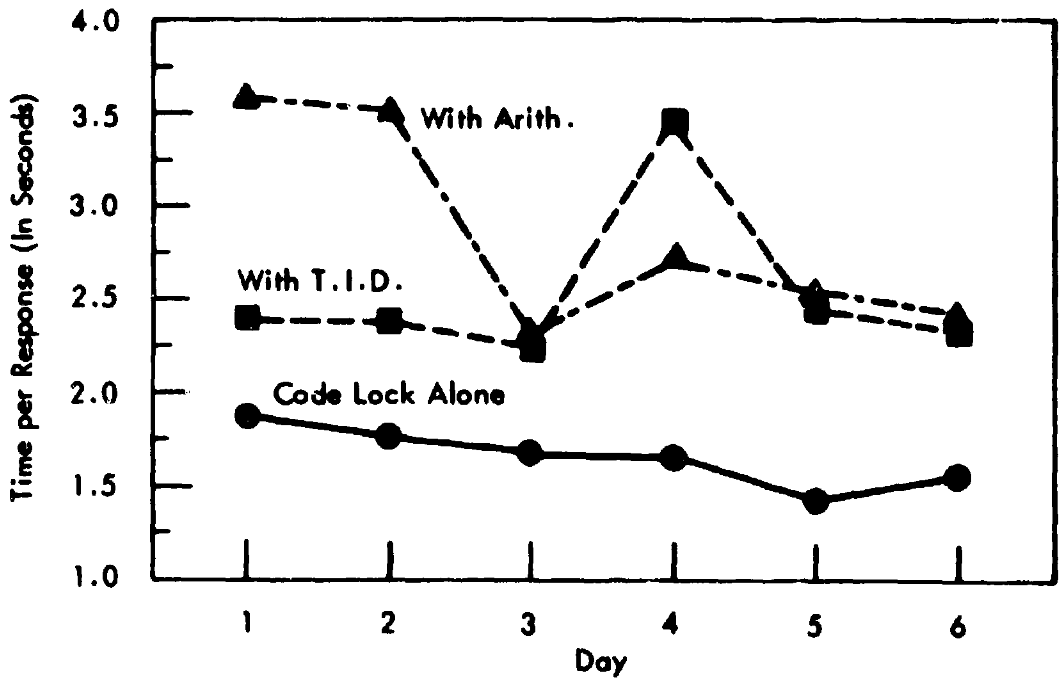


TABLE V

SUMMARY OF ANALYSES OF VARIANCE FOR CODE-LOCK RESPONSES

| | | Sequences per Minute | | Percent Erroneous Response | | Time per Response | |
|---|---|---|---|---|---|---|---|
| Source of Variation | d. f. | Mean Square | F | Mean Square | F | Mean Square | F |
| Days | 5 | .0199 | 2.55 | 3.11 | ---- | .430 | 1.38 |
| Response Conditions | 2 | .3399 | 43.58** | 11.63 | 1.15 | 4.506 | 14.44** |
| DR | 10 | .0059 | ---- | 8.86 | ---- | .326 | 1.04 |
| Groups | 1 | .1754 | 22.49** | 0.05 | ---- | 4.417 | 14.15** |
| DG | 5 | .0037 | ---- | 2.35 | ---- | .216 | ---- |
| RG | 2 | .0324 | 4.15* | 10.13 | 1.00 | .933 | 2.99 |
| DRG | 10 | .0078 | | 10.10 | | .312 | |
| TOTAL | 35 | | | | | | |

* _P_ less than .05

** _P_ less than .01

# SECTION IV

# CONCLUSIONS

This study investigated the performance of 2 small groups of men on a test battery of 6 tasks. Three of these tasks were passive in nature, requiring only vigilance or monitoring by the operator for detection of a critical signal; these were: auditory vigilance, warning-lights monitoring, and probability meter monitoring. The other 3 tasks—arithmetic computations, target identification, and code-lock solving—required more active attention of the operators, and 2 of these tasks (target identifications and code-lock solving) were group tasks requiring interactions among the crewmembers. It was hypothesized that concurrent presentation of active and passive tasks would have a detrimental effect on vigilance and monitoring performance. While previous studies suggested the hypothesis, its truth was not known with certainty, since the previous studies involving the 6 tasks did not attempt to evaluate the effects of task load on vigilance and monitoring performance.

The principal purpose of this study was the evaluation of vigilance and monitoring performance for 3 such tasks with and without simultaneous presentation of the more active tasks. On the basis of results obtained, the following conclusions seem justified:

- Presentation of vigilance and monitoring tasks concurrently with tasks requiring more active attention of an operator has a detrimental effect on the operator's monitoring performance.

- The detrimental effects of increased task load do not appear to be long-term in nature, since removal of the additional (active) tasks from the task program invariably resulted in recovery to previously attained performance on the vigilance and monitoring tasks.